IN THE CLAIMS:

1. (Original) A device for inspecting solder connections between a component and a substrate or between two components or substrates, the device comprising:

an image receiving unit;

an image transmitting device, including a first end and a second end, the first end coupled to said image receiving unit;

a tip assembly removably coupled to said second end of said image transmitting device, said tip assembly further including a reflective device and an image receiving aperture, the tip assembly configured to transmit an image of said solder connections received by said reflective device, through said image transmitting device, to said image receiving unit; and

an illumination device including at least one light emitting aperture disposed adjacent said image receiving aperture, said light emitting aperture directed towards said solder connections to be inspected.

2. (Original) The device according to Claim 1, wherein the image receiving unit comprises a camera.

3. (Original) The device according to Claim 2, wherein the image transmitting device includes a generally cylindrical body having a plurality of lenses disposed therein.

4. (Original) The device according to Claim 1, wherein the image receiving unit includes a lens assembly coupled thereto, said lens assembly capable of increasing or decreasing magnification of said image to be received therein.

5. (Original) The device according to Claim 1, wherein said illumination device includes light source and a device for transmitting light from the light source to the light emitting aperture.

6. (Original) The device according to Claim 1, wherein said image receiving unit is disposed within a housing, said housing pivotally attached to a frame.

7. (Original) The device according to Claim 6, wherein a pivot point of rotation of said housing is the optical centerline of said mirror disposed within the tip assembly.

8. (Original) The device according to Claim 7, wherein said image transmitting device and said tip assembly are rotatable about an axis perpendicular to said substrate.

9. (Original) The device according to Claim 1, wherein said aperture filters the image to be transmitted prior to transmission of the image by the image transmitting device.

10. (Original) The device according to Claim 1, further including a display device coupled to said image receiving unit, the display device configured to display the solder connections to be inspected.

11. (Original) The device according to Claim 1, wherein said tip assembly further includes an illumination aperture disposed on either side of said image receiving aperture, wherein said illumination apertures direct light onto said solder connections to be inspected.

12. (Original) The device according to Claim 6, wherein said angle of pivot is between about 0 and about 5 degrees.

13. (Original) The device according to Claim 1, further including a back lighting assembly, the back lighting including an illumination source, a lens assembly, and a flexible arm coupled thereto.

14. (Original) The device according to Claim 5, wherein said device for transmitting light is a fiber optic device.

15. (Original) The device according to Claim 1, wherein the illumination device includes a light emitting diode disposed within said light emitting aperture and a power source coupled to said light emitting diode.

16. (Original) A device for optically inspecting soldered connections, the device comprising:

a camera;

a image transmitting device, including a generally circular cross-sectional profile first end and a second end and a bore extending therethrough, said first end coupled to the camera, and a at least one image transmitting lens disposed within the bore;

a tip assembly removably coupled to said second end of said transmitting device, said tip assembly further including a mirror and an image receiving aperture disposed adjacent to said mirror, said image receiving aperture and said mirror configured to receive and transmit an image the soldered connections to said camera through said image transmitting device; and

at least one illumination device, the illumination device comprising a light source, a device for transmitting light from the light source to a light transmitting aperture disposed within said tip assembly, the light transmitting aperture disposed adjacent to the image receiving aperture.

17. (Original) The device according to Claim 16, further including a magnifying lens disposed between the camera and the first end of the image transmitting device, the magnifying lens capable if magnifying the image of the soldered connection.

18. (Original) The device according to Claim 16, wherein said camera, image transmitting device, and tip assembly are rotatably and pivotally coupled to a movable arm,

the movable arm coupled to a frame, the frame including a work surface configured to receive a circuit board to be inspected, the camera, image transmitting device and tip assembly being disposed generally perpendicular to said work surface.

19. (Original) The device according to Claim 18, wherein the camera, image transmitting device, and tip assembly are pivotable between about -10 and about 10 degrees relative to an axis extending perpendicular from said work surface.

20. (Original) The device according to Claim 19, wherein the camera, image transmitting device, and tip assembly may be rotated about said perpendicular axis.

21. (Original) The device according to Claim 20, further including a second illumination device, the second illumination device comprising a flexible shaft extending from said arm and a tip assembly, the tip assembly including a light transmitting aperture, wherein a light transmitting device is connected at one end to a light source and at the other end to the light transmitting aperture, the second illumination device configured to move independent of said camera, image transmitting device, and said tip assembly.

22. (Currently Amended) A method of inspecting soldered connections between an IC and a circuit board, the method comprising:

~~a~~ disposing a circuit board having at least one IC soldered thereto on a work surface of an inspection device;

aligning a tip of the inspection device with a row of soldered connections to be inspected;

illuminating the soldered connections to be inspected through a light emitting aperture disposed upon the tip of the inspection device;

visually examining the soldered connections between the IC and the circuit board through an image receiving aperture disposed upon the tip of the inspection device;

pivoting the tip assembly about an optical centerline of a ~~said~~ reflective device disposed within the tip assembly to view the upper or lower solder connections;

rotating said tip assembly through about 180 degrees to view the sides of the soldered connections; and

visually inspecting the gaps formed between the soldered connections for optical clarity.

23. (Currently Amended) The method according to Claim 22 ~~20~~, wherein the step of illuminating further comprises using a second illuminating device to illuminate the soldered connections from a direction opposite to the image receiving aperture.

REMARKS

Objection to the Drawings:

The Examiner objected to the drawings as missing identifying numbers for tip 41, shaft 44, fiber 45 and pivot plate 111.

The attached sheets of drawings include changes to Figs. 1 and 3. These sheets replace the original sheets of Figs. 1 and 3. Figures 1 and 3 have been suitably amended to conform to the specification, as required.

Section 112 Rejections:

Claim 22 was rejected as lacking sufficient antecedent basis for "said reflective device". Claim 22 has been amended to set forth a reflective device being disposed within the tip assembly. (See page 9, lines 13 to 15 for support).

Claim 23 was rejected as being a method claim depending from device claim 20. Claim 23 should properly depend from claim 22. Suitable correction has been made.

Section 103 Rejections:

Claims 1 to 23 were rejected as being obvious over Cannon in view of Heffels.

(a) The Presently Claimed Invention:

Independent claims 1 and 16 set forth a device having a separate: (1) *light emitting aperture,* and (2) *image receiving aperture*. Additionally, claims 1 and 16 each set forth the light emitting aperture being disposed adjacent to the image receiving aperture, with

both *the light emitting and image receiving apertures located on a tip assembly that is removably coupled* to an image transmitting device.

Similarly, claim 22 sets forth illuminating soldered connections through a light emitting aperture upon the tip of the inspection device, and visually examining the soldered connections *through a (separate) image receiving aperture that is also disposed upon the tip of the inspection device.*

As stated above, the presently claimed invention has a first aperture through which light passes to illuminate the object (i.e. its light emitting aperture), and a second aperture through which the object is viewed (i.e. its image receiving aperture).

An advantage of this design is that it *separates* the illumination light path from the "optical path" (i.e. the imaging light path). As such, the present design avoids the problem of illumination light simply being reflected from the soldered connections back up through the image transmitting device. Moreover, the present design has the advantage of restricting the amount of light that first enters the lens assembly, thereby sending a crisp image to the camera by blocking excess light from the light sources from being transmitted to the camera. (See page 11, lines 19 to 22; page 12, lines 17 to 26 in particular).

A further advantage of the presently claimed invention is that both the image receiving aperture and the illumination aperture are located on the same removable tip of the device. Thus, substitutable tips can be formed, each having diameters with different angles, thicknesses, and/or height for different applications. Moreover, the mirror in such a removable tip can easily be replaced when it breaks by simply replacing the tip assembly itself, thus avoiding the high cost of repairing the lens assembly.

(b) The Cited Art:

Cannon discloses a visual inspection device including a camera with a fiber optic tube extending down from the camera to the object to be viewed. The object to be viewed is illuminated by a light source that passes light down through the same fiber optic tube. Specifically, illumination light passes from a light source down through the fiber optic tube to the object to be viewed, with reflected light then passing back up through the same fiber optic tube to the camera.

Heffels discloses a system for spectroscopic analysis of a fluid by simultaneously directing first and second light beams (having different polarity) toward a boundary in the fluid then and measuring the intensity of the reflection of the two light beams. In Heffels, the light beams are reflected across an internal surface at the end of the device, when the end of the device is submerged in the fluid.

(c) The Cited Art Distinguished:

Claims 1 to 23 were rejected over Cannon in view of Heffels. In setting forth this rejection, the Examiner stated that Cannon does not disclose the use of apertures on its probe tip to adjust the lighting and imaging process. In addition, the Examiner stated that Heffels does not disclose an image receiving aperture disposed adjacent to a light emitting aperture. In fact, the Examiner stated that Heffels does not disclose a plurality of apertures at all.

However, the Examiner stated that since Heffels discloses a single "aperture", it would therefore be obvious to add additional apertures. Such multiple apertures could

allegedly be incorporated into the Cannon system to yield a device that would render the present invention obvious.

The Applicants disagree with this conclusion, as follows.

First, as stated above, the presently claimed invention sets forth separate light emitting and image receiving apertures located on a removable tip assembly that is coupled to an image transmitting device. As stated, an advantage of the presently claimed invention is that it separates the illumination light path from an "optical" path (i.e. its image receiving light path). In contrast, Cannon uses the same light path for both illumination and image transmission. This approach degrades the image clarity of the Cannon system as compared to the present invention. (See page 3, lines 21 to 24 of the specification). *There is no teaching in Cannon for such light path separation. Simply adding an additional aperture to the Cannon system would not result in the presently claimed invention's separation of illumination and imaging light paths.*

Second, Heffels' "aperture" is completely different from the two separate apertures that are presently claimed. Specifically, Heffels' aperture 31 is merely an *internal opening within the device* through which the diameters of light passing through optical fibers 14, 15, 20 and 21 are limited (Co. 9, lines 57 to 67). The Heffels system operates on "total internal reflection" of light beams of different polarity. IE: light is internally reflected across an internal surface at the end of the device (see light path in Figs. 5 and 6). The distal end of the Heffels device is submerged in a fluid (see Fig. 1). Thus, Heffels' aperture 31 is not an external opening. If it were an external opening, the device would simply fill with fluid, making it inoperable. Therefore, the Applicants submit that Heffels' *single*

internal opening could not render obvious the present invention's *pair of external openings* which permit light to pass out of the device to the object (i.e.: the illumination aperture) and from the object to the camera (i.e. the imaging aperture).

Third, the presently claimed invention provides a system in which *both apertures are disposed on a single removable tip* of the device. This aspect of the presently claimed invention is not seen in either of the Cannon or Heffels references. As stated above, the presently claimed invention has the advantage that should the mirror become dirty or damaged, the tip can simply be replaced (with a tip having another mirror therein) quickly and easily. Moreover, different tips can be manufactured with different thicknesses, heights or angles, providing an easy system for adjusting desired image properties.

Conclusion:

For the reasons presented above, all claims are believed to be in condition for allowance. A Notice of Allowance is therefore respectfully requested.

Should the Examiner feel that a telephone conference would advance prosecution of the present application, he is invited to call the undersigned attorney at the number listed below.

Respectfully submitted,
BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: David Heckadon

David R. Heckadon
Registration No. 50,184

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300

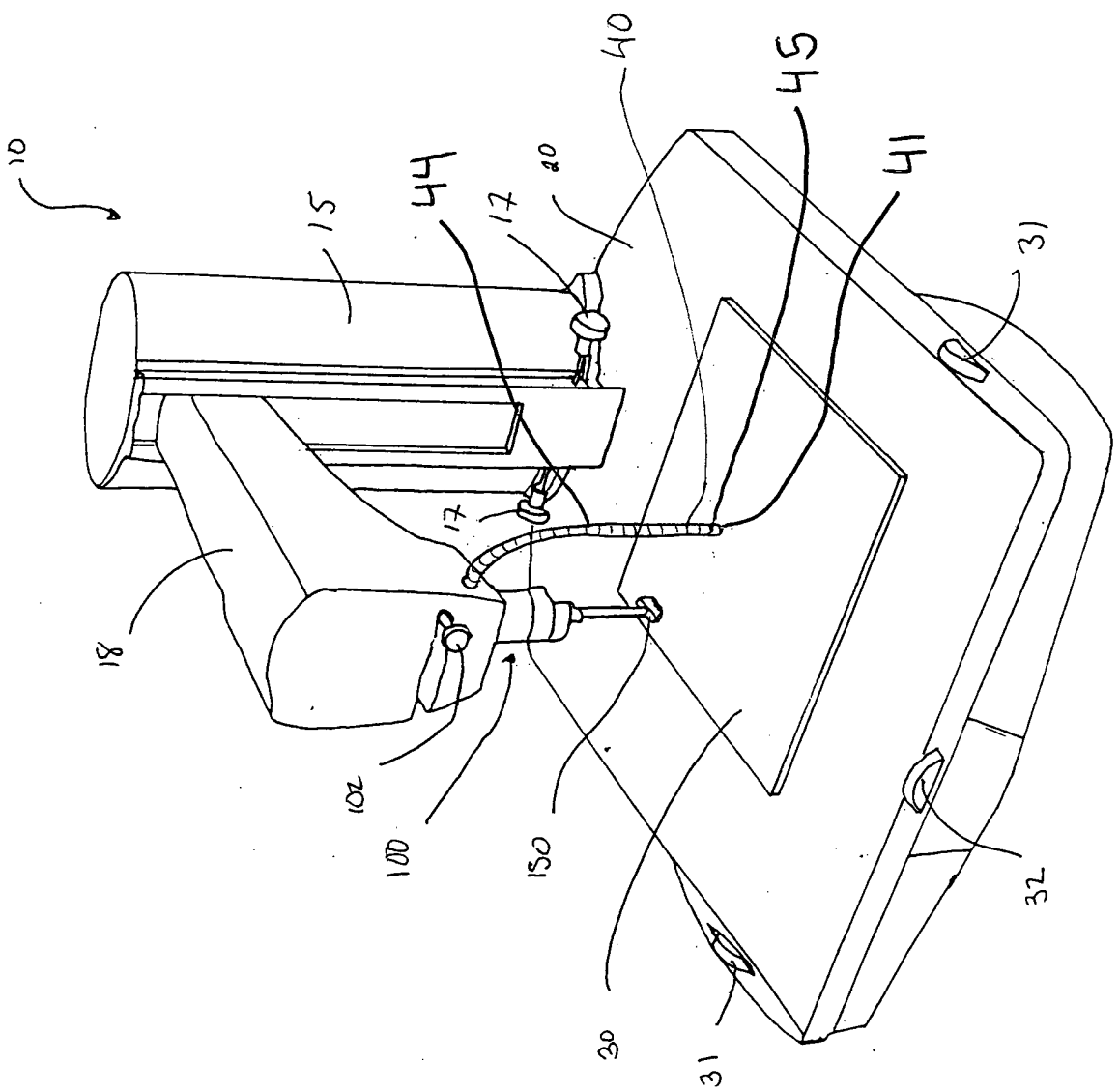

Figure 1

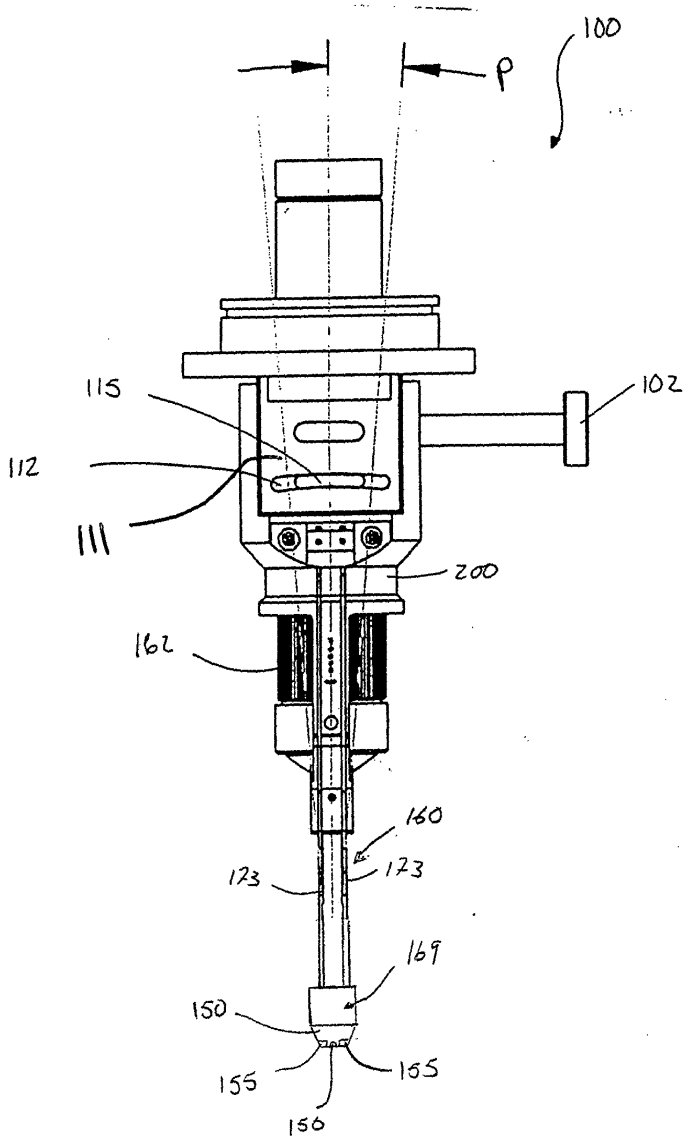

Figure 3